

X-ray Diffraction on Mars: Scientific Discoveries Made by the CheMin Instrument

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The Mars Science Laboratory *Curiosity* landed in Gale crater in August 2012 with the goal to identify and characterize habitable environments on Mars. *Curiosity* has been studying a series of sedimentary rocks primarily deposited in fluviolacustrine environments ~3.5 Ga. Minerals in the rocks and soils on Mars can help place further constraints on these ancient aqueous environments, including pH, salinity, and relative duration of liquid water. The Chemistry and Mineralogy (CheMin) X-ray diffraction and X-ray fluorescence instrument on *Curiosity* uses a Co X-ray source and charge-coupled device detector in transmission geometry to collect 2D Debye-Scherrer ring patterns of the <150 micron size fraction of drilled rock powders or scooped sediments. With an angular range of $\sim 2-52^\circ 2\theta$ and a 2θ resolution of $\sim 0.3^\circ$, mineral abundances can be quantified with a detection limit of $\sim 1-2$ wt.%. CheMin has returned quantitative mineral abundances from 16 mudstone, sandstone, and aeolian sand samples so far. The mineralogy of these samples is incredibly diverse, suggesting a variety of depositional and diagenetic environments and different source regions for the sediments. Results from CheMin have been essential for reconstructing the geologic history of Gale crater and addressing the question of habitability on ancient Mars.